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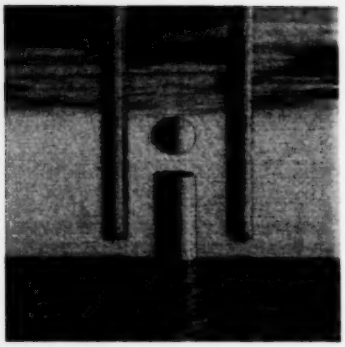
The Canadian Productivity Review

Productivity Performance in Canada, 1961 to 2005



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Symbols

The following standard symbols are used in Statistics Canada publications:

.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
p	preliminary
r	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
E	use with caution
F	too unreliable to be published

The Canadian Productivity Review

The Canadian Productivity Review is a series of applied studies that address issues involving the measurement, explanation, and improvement of productivity. Themes covered in the review include, but are not limited to, economic performance, capital formation, labour, prices, environment, trade, and efficiency at both national and provincial levels. The Review publishes empirical research, at different levels of aggregation, based on growth accounting, econometrics, index numbers and mathematical programming. The empirical research illustrates the application of theory and techniques to relevant public policy issues.

The primary distribution medium for this series is the Internet. These studies can be downloaded from the Internet at *www.statcan.ca* for free.

All papers in **The Canadian Productivity Review** go through institutional review to ensure that they conform to Statistics Canada's mandate as a government statistical agency and adhere to generally accepted standards of good professional practice.

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The level of uncertainty will depend on several factors: the nature of the functional form used in the multivariate analysis; the type of econometric technique employed; the appropriateness of the statistical assumptions embedded in the model or technique; the comprehensiveness of the variables included in the analysis; and the accuracy of the data that are utilized. The peer group review process is meant to ensure that the papers in the series have followed accepted standards to minimize problems in each of these areas.

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Abstract

This study examines Canadian productivity performance over the period from 1961 to 2005. It investigates labour productivity growth and the sources of improvements therein—multifactor productivity growth, capital intensity and skill upgrading. It also examines the contribution that productivity growth has made to economic growth and to the improvement of living standards. Finally this study investigates the share of income going to labour, and the real hourly compensation of workers.

This publication makes use of the new KLEMS database that was released on June 25, 2007 (*www.statcan.ca/english/freepub/13-605-XIE/13-605-XIE2007005.htm*).

Productivity Performance in Canada

1 Introduction

Exhortations for improved Canadian productivity performance are common. To contribute to the debate in this domain, this study explains the concept of productivity and Canada's historical performance in this area.

The first section of this study defines productivity and addresses the question of why Canadians should be concerned about productivity performance. The answer is that productivity growth is a key factor contributing to sustainable economic growth and improving the material living standards of Canadians. The influence of productivity growth on living standards accumulates slowly over long periods of time. Its effect becomes apparent only over decades. Small annual improvements in productivity growth, if sustained, add up to substantial improvements in living standards over time. A 2% compound annual increase in output per worker implies that it doubles in about 35 years.

The second section of this study assesses Canada's long-term productivity performance. Canada's productivity growth improved in the 1990s, though this performance still remains below the one experienced in the early 1960s. This improved performance will need to be sustained, and even improved, if the Canadian economy is to meet the aspirations of Canadians and to improve the living standards of current and future generations.

2 Main findings of this study

- Labour productivity advanced at 2.1% annually over the 1961-to-2005 period.
- Productivity matters for growth. Real gross domestic product (GDP) increased by 3.9% over that period. Productivity growth has accounted for more than half of the increase in Canada's output over the 1961-to-2005 period.
- Productivity matters for living standards. Real GDP per person in 2005 was over 2.7 times higher than in 1961. Productivity growth accounted for 82% of that increase.
- Productivity growth matters for income distribution. Over the last forty-five years, real hourly compensation of workers has generally tracked labour productivity gains closely.

3 Why should we care about productivity?

Compare Canada today with earlier times, and one fact stands out: Canadians live better.

A good deal of the credit for this improvement should go to improvements in productivity. Through it, Canadians get more goods and services from the effort that they devote to work. Through it, they secure economic progress and earn bigger paycheques. The power of productivity has made Canada more prosperous.

Productivity is improved by increasing the efficiency with which the production system transforms inputs into outputs. Canada has prospered by improving the efficiency of its production system in a number of different ways. Workers today can produce more per hour worked because of a number of changes. Canada has become more productive by

- building capital—adding more machinery, factories, offices and research facilities that workers can employ in the production process;
- upgrading workers' skills, whether through formal schooling, on-the-job experience or retraining;
- introducing new technologies that increase output, improve efficiency and lower costs;
- improving the organization of production processes.

Canada has become more productive also through trade: companies gain access to cheaper inputs, a deeper pool of investment funds and technology from around the world. Trade enlarges markets, thereby allowing companies to grow larger and to exploit economies of scale that contribute to improved efficiency.

History shows us the impact of productivity growth. At its founding in 1867, Canada was primarily agrarian, with more than 90% of the population toiling on farms. As tractors, threshers, irrigation and high-yield seeds made individual farmers more productive over the past century or so, Canada could feed itself—and expand its export markets—with far fewer agricultural workers.

Displaced farmers flocked to cities, where they found work assembling cars, building houses, generating electricity and making an abundance of consumer goods. Over time, factories became more automated and experienced large gains in productivity. Workers moved from assembly lines to jobs in retailing, medical care, finance, management and services.

Over the course of our history since confederation, the cumulative effects of productivity on living standards have been astounding. Per-person output has grown 25-fold since 1870. In just the past two generations, average real income in Canada has more than doubled, thanks largely to increased productivity.

As societies get richer, they expand the type of goods consumed. A hundred years ago, most income was devoted to the basics of food, clothing and shelter. As output per hour increased steadily over the years, Canadians have taken advantage of their added productivity in the form of material gains—more cars, bigger and better-equipped houses, an abundance of other goods and services—including publicly provided health care.

As a result of productivity gains, Canadians have not only steadily increased their consumption of material goods, but also have increased their leisure time. Productivity growth has allowed Canadians to reduce the annual average number of hours worked per job from 2,364 hours in 1947 to 1,986 in 1970 and to 1,738 today.

4 What do productivity statistics show?

Statistics Canada measures the growth in productivity that occurs over time. Productivity statistics provide a snapshot of increases in the efficiency of the Canadian economy. Changes in productivity capture our progress in improving our capability to produce output as we increase our inputs. Productivity growth thus captures the increase in our production efficiency. Increases in productivity stem from improvements in knowledge and in production techniques. These increases can occur when plants become larger and exploit scale economies, use higher-quality labour, or introduce better-quality products. They can also arise from organizational changes in management or the way in which production is organized on the shop floor.

In an economy as large and diverse as that of Canada, it's a Herculean task to calculate a summary statistic for productivity that, in 2005, sums up the efforts of 16.2 million workers, employed in millions of establishments that produce almost about $1.4 trillion in output. Statistics Canada does so in its productivity program, which uses an integrated set of data sources produced by the System of National Accounts.

This section provides empirical estimates of the extent to which productivity growth contributes to economic growth and improvements in our real income. The assessment of Canada's productivity performance begins with a review of the historical record. Past productivity growth is examined to provide a historical benchmark.

The first step in assessing productivity performance is to take stock of what the available productivity measures cover and what they mean.

Output growth must come either from growth in inputs and/or from growth in productivity. Indeed, this is the principle that underlies the basic method of estimating productivity growth (see box below). Productivity growth is the growth in output in excess of that of inputs, like labour.

The basics of estimating productivity growth

Productivity growth cannot be directly observed and measured. Rather, it is calculated as the growth in the amount of output relative to the amount of resources used to produce that output.

Partial productivity measures output growth relative to the growth in one particular input. The growth in **labour productivity** is calculated as the growth in output per unit of labour. Similarly, the growth in **capital productivity** is calculated as the growth in output per unit of capital input.

The most commonly used measure of partial productivity growth is labour productivity. It will be affected by the amount of capital that is provided to workers. Capital is simply the investment made in machinery, equipment and buildings. Plants that have more capital tend to have a higher output per hour worked.

Since it is important to know whether output per hour worked is high or low, or if it changes only because of the amount of capital that is being provided to workers as opposed to other factors like technical change, Statistics Canada also produces what has become known as a **multifactor productivity** measure. It bundles both labour and capital together in an input measure, and measures the amount of output produced by a standardized input bundle that is made of labour and capital.

5 Economic growth and productivity performance

GDP growth rates calculated over short time periods fluctuate considerably owing to business cycles. When analyzing a country's long-term performance, we want to measure the trend in economic growth. That is, we want to measure economic growth without business cycle effects. There are several ways of doing this. One common approach is to measure GDP growth over the economic cycle. This is done by calculating the average growth rate between two consecutive peaks of the cycle.

Nevertheless, it should be recognized that there is no ideal time horizon over which an average economic growth rate should be calculated. If the average growth rate is calculated over a short time period, average economic growth rates are likely to fluctuate considerably owing to business cycle effects. If the average growth rate is calculated over a longer time period, significant changes in the growth performance of an economy may not be apparent for some time. For example, if the Canadian economy experienced an increase in its trend GDP growth in the very recent past, this improvement would not become apparent for some time if a longer-run average growth rate were being used.

Chart 1 contains the average annual growth of real GDP in the business sector[1] over the 1961-to-2005 period and its various sub-periods, reflecting different economic cycles. Over the whole period, economic growth increased at 3.9% per year on average. Economic growth was quite remarkable during the 1960s, averaging 5.6% annually. Beginning in the 1970s, economic growth has experienced a steady slowdown, from 4.1% during the 1970s, down to 3.3% in the 1980s and 3.0% in the 1990s.

1. *The business sector is the total economy excluding non-commercial activities and the owner-occupied proportion of residential housing.*

Output growth can be driven by the increase in the resources devoted to production or the efficiency with which these resources are employed. Consider the case of labour input. Output will increase if there are more hours worked or if workers produce more per hour worked (if labour productivity goes up):

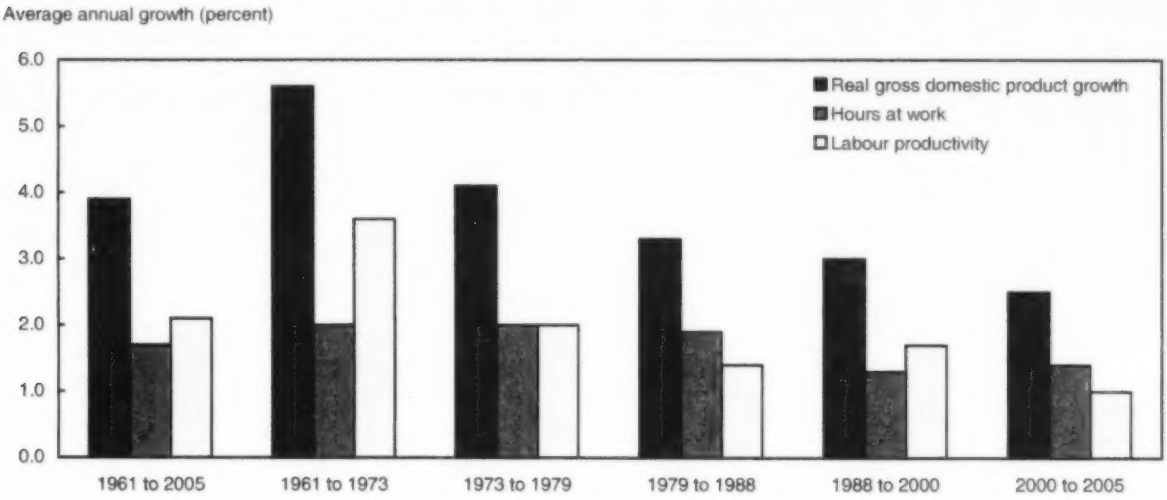
(1) $$GDP = (GDP / Hours) * (Hours)$$

where *Hours* is the total number of worker-hours.

Again chart 1 depicts changes in each of these factors over time. For the entire 1961-to-2005 period, labour productivity advanced at a 2.1% annual average, accounting for slightly more than half of the increase in GDP growth. The rest is attributed to hours which increased at 1.7% per year on average.

Much of the decline in economic growth that took place from the 1960s to the 1970s was attributable to a slowdown in labour productivity growth—from 3.6% to 2.0%. In contrast, the slowdown in economic growth in subsequent periods was due to the downward trend in the number of hours at work. Productivity growth was slightly higher in the 1990s than in the 1980s.

Chart 1
Trend in real gross domestic product, labour productivity and hours at work, business sector



Source(s): Statistics Canada, Canadian Productivity Accounts.

6 Contribution of productivity growth to living standards

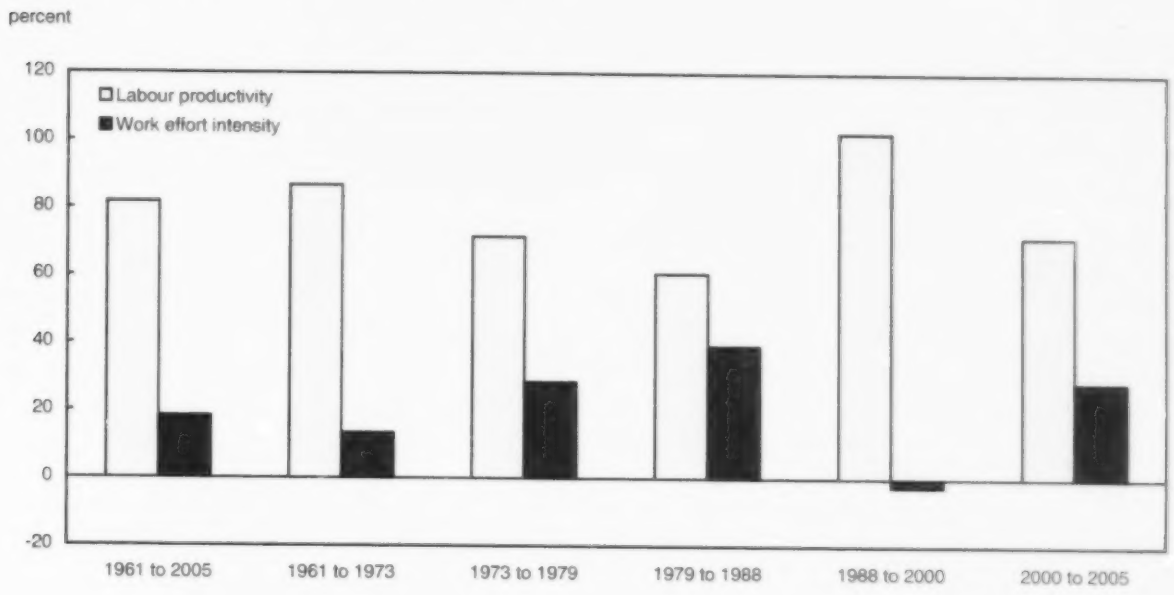
Productivity growth can also be related to changes in aggregate living standards—when the latter is measured as GDP per capita.

GDP per capita is equal to the product of GDP per hours worked and the ratio of the number of hours worked to the total population:

(2) $$GDP / Pop = (GDP / L) * (L / Pop)$$

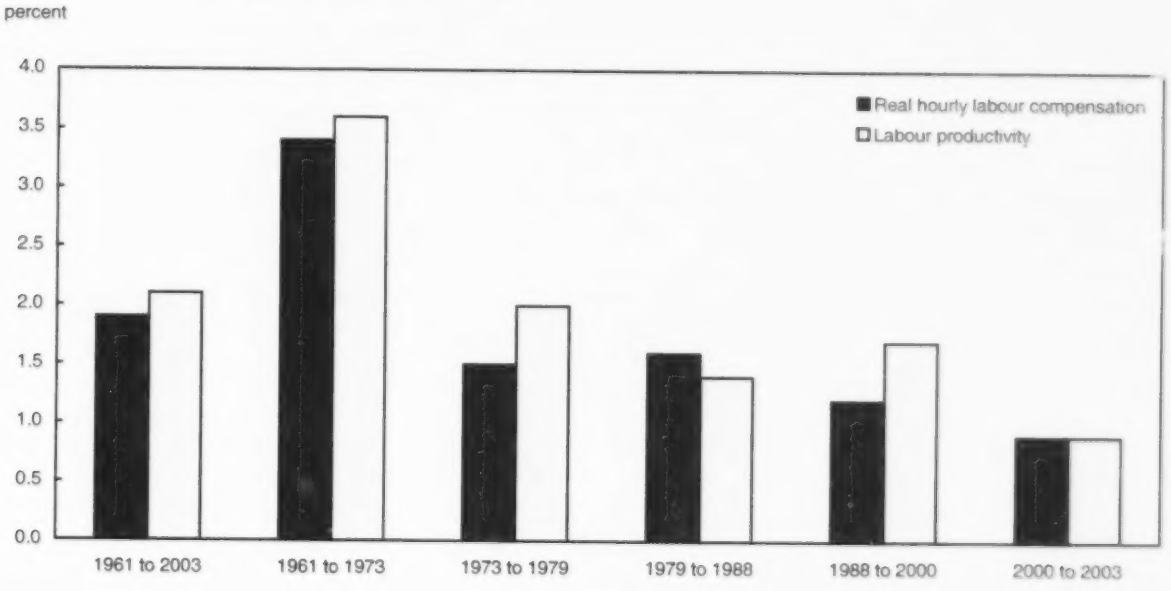
where *L* is the total number of hours worked and *Pop* is the population.

Chart 2
Sources of growth of real gross domestic product per person



Source(s): Statistics Canada, Canadian Productivity Accounts.

Chart 3
Labour productivity gains and real hourly labour compensation



Source(s): Statistics Canada, Canadian Productivity Accounts.

Increases in GDP per capita in the total economy can come either from an increase in labour productivity or from increases in the 'work effort' of the population—the number of hours worked per person. The latter is the product of the average hours worked by those who are employed and the ratio of the number of employed persons to the population.

Chart 2 depicts the share of total growth in real GDP per person that was accounted for by the growth in labour productivity. In each period, labour productivity has accounted for the bulk of real GDP growth.

However, it should be noted that there were substantial increases in the percentage of the population at work in the 1970s and 1980s, which was due mainly to the higher participation rate of women. This contributed substantially to the increase in the standard of living during this period.

7 Distributing the gains from productivity growth

Aggregate GDP measures the returns to both labour and capital. Distributional concerns lead to questions about whether the share going to labour increases over time and, in particular, how productivity growth is related to real income.

The previous section made the point that productivity growth raises living standards. But how does this actually come about? The most direct way in which productivity improvements benefit people is by raising their real incomes. If higher productivity means lower costs and these savings are passed on in lower prices, consumers will be able to purchase goods and services at less cost. The increased spending that these higher real incomes allows produces flow-on effects throughout the economy.

To see the relationship, chart 3 compares the trend in labour productivity and real hourly labour compensation over time.[2] The picture that emerges from this figure is that real hourly labour compensation and labour productivity are closely related in the long run. Most of the increase in productivity was passed through to an increase in real hourly labour compensation during the 1960s, 1970s, 1980s and 1990s. The deterioration in labour productivity over time translated into a slowdown in the growth in real hourly labour compensation.

8 Where do increases in labour productivity come from?

Since increases in labour productivity are associated with higher economic growth, higher standards of living and higher real incomes, analysts have investigated the sources of improvements in labour productivity.

There are many reasons behind the growth in labour productivity—higher capital available to the workforce, a higher proportion of skilled workers, increases in plant scale, changes in organizational structure, and increases in technology.

The Canadian Productivity Accounts can be used to divide labour productivity growth into the part coming from increases in capital intensity, increases in skill levels of workers (referred to here as a change in labour composition)[3] and from all other sources—what is referred to as multifactor productivity growth:

(3) $$\Delta GDP / Hours = (\Delta MFP) + S_k \cdot \Delta(Capital / Hours) + S_l \cdot \Delta LC$$

where $\Delta GDP / Hours$ is the growth in labour productivity, ΔMFP is the growth in multifactor productivity, S_k is the share of GDP accruing to capital, $\Delta(Capital / Hours)$ is the growth in the amount of capital available per hour worked, S_l is the share of GDP accruing to labour, and ΔLC is the growth in the measure of labour skills.[4]

2. *Real hourly labour compensation is derived from the System of National Accounts concept of labour compensation divided by the gross domestic product implicit price deflator for the business sector.*
3. *See Wulong Gu, Mustapha Kaci, Jean-Pierre Maynard and Mary-Anne Sillama, 2003, "The changing composition of the Canadian workforce and its impact on productivity growth," in Productivity Growth in Canada – 2002, John R. Baldwin and Tarek M. Harchaoui (eds.), catalogue no. 15-204-XIE2001000, Ottawa: Statistics Canada.*
4. *See John R. Baldwin and Wulong Gu, 2007, Investment and Long-term Productivity Growth in the Canadian Business Sector, 1961 to 2002, The Canadian Productivity Review, catalogue no. 15-206-XIE2007006, Ottawa: Statistics Canada.*

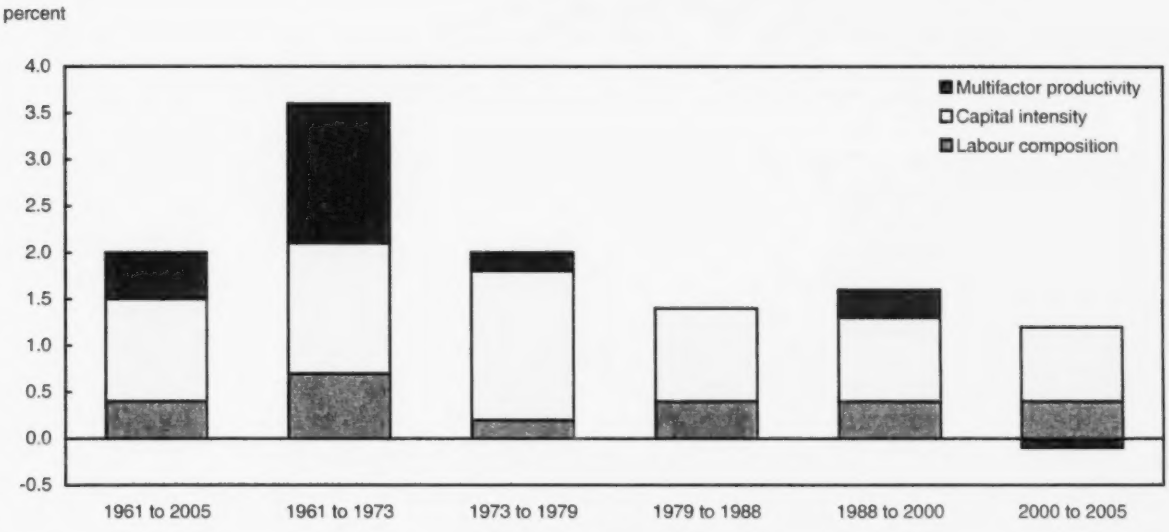
Labour productivity can grow as a result of higher capital use per worker. For example, stronger investment in information technology can raise capital intensity. As information technology has become less expensive, firms have substituted information technology for labour and other forms of capital.

Labour productivity can grow also as a result of a higher proportion of skilled workers. Upgrading workers' skills can increase labour productivity. Canadian companies can upgrade their workers' skills through formal schooling, on-the-job experience or retraining.

Multifactor productivity captures all other effects. It is the residual factor capturing a host of influences—amongst them, changes in technology.

In chart 4, we have broken down the growth in labour productivity into increases in capital intensity, labour skill levels and multifactor productivity. Over the period from 1961 to 2005, the 2.1% increase in labour productivity can be decomposed into a 1.1% increase capital intensity, a 0.4% increase arising from higher labour skill levels, and a 0.5% increase due to a growth in multifactor productivity.

Chart 4
Sources of labour productivity growth, business sector



Source(s): Statistics Canada, Canadian Productivity Accounts.

The deterioration in labour productivity growth from the 1960s to the 1970s resulted primarily from the slowdown in multifactor productivity growth from 1.5% to 0.2%, and to a lesser extent, a slowdown in the growth in labour composition due to a slower growth in skilled labour (from 0.7% to 0.2%). The contribution made by capital intensity increased from 1.4% to 1.6%.

The slowdown in labour productivity from the 1970s to the 1980s, from 2.0% down to 1.4%, was primarily the result of a decline in capital intensity and, to a lesser extent, to a decline in multifactor productivity performance.

Labour productivity performance in the 1990s reflected a turnaround in the multifactor productivity growth. The contributions of capital intensity and labour composition were virtually unchanged since the 1980s.

The post-2000 period has seen a further decline in labour productivity growth. This decline is due to a decline in capital intensity and a much larger decline in multifactor productivity growth.[5] The decline in multifactor

5. *See Statistics Canada, 2007, "Study: Investment and long-term growth in labour productivity." The Daily, Communications and Library Services Division, catalogue no. 11-001-XIE, June 25, Ottawa: Statistics Canada.*

productivity growth accounted for 65% of the decline in labour productivity growth from the 1988-to-2000 period to the 2000-to-2005 period. The decline in capital intensity accounted for 27% of the decline.

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